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THE DEDICATION OF THE NEW BUILDING OF MELLON INSTITUTE[1]

INTRODUCTORY REMARKS AND COMMENTS

By Dr. E. R. WEIDLEIN

DIRECTOR OF THE INSTITUTE

Honorable Andrew W. Mellon, Mr. Richard K. Mellon, distinguished guests, friends of Mellon Institute and friends of our radio audience: We extend to you our sincere appreciation for your presence. We are stimulated by an audience of leading scientists, educators and industrialists, who are here to pay tribute to our founders in dedicating this magnificent new building to science for the benefit of humanity. In this we all take pride; and as that occasion has now approached, let me say a word about the meaning of the institute and about the purpose of its founding.

Before they established the institute in 1913, Andrew W. Mellon and the late Richard B. Mellon, the father of Richard K. Mellon, saw the merit of scientific research for the benefit of mankind through the development of industry. Industries of that day, however, were not applying scientific research for the solution of their problems, nor were these industries fully aware as to what such research might mean to them. The institute was established for the purpose of giving this aid.

This venture of scientific research very soon proved its value. New materials and new processes came into being. Industries and the whole estate of man benefited. Yet the founders saw beyond these results. It seemed to them that there were needed researches in science that have a more direct relation to human welfare, which might also advance our basic knowledge of science. Such fundamental work was started; and

[1] Pittsburgh, Pa., May 6, 1937.

the entire program through these many years has been sustained with generosity by the founders.

The institute has become a guild of scientists. Here are gathered many men trained in chemistry, biology, physics and engineering. They help one another directly; and, even more important, they create an atmosphere of achievement for themselves in which there grow vision and determination for thorough, careful work. Their success is not accidental. It is the outcome of strong minds and of orderly thought, of good will and of good teamwork, of seeking toward a great end. Even the founders did not entirely foresee the results to be attained by such a guild, nor did they anticipate, in the days of the beginning, the full values to humanity which would flow from such researches.

As one who has had association with the founders through many years, their quiet, unpretentious guidance of the institute has deeply impressed me. Richard B. Mellon has gone. He had the satisfaction, however, of seeing the four walls of the new building completed. He was happy to watch the columns go into place; and he was happy, too, that he was regarded as a member of the guild. His courage, his patience and his imagination qualified him as a great and always to be honored member.

Of Andrew W. Mellon it is more difficult to speak, for he is here. His mind always proceeds through details to the final significance, and he seems never to be disheartened. These qualities of mind as a background to the endless discouragements and elusive headway of scientific research can be understood, it seems to me, best by one who has lived through large experience with such difficulties.

Their contribution is a noble gift to humanity.

We are delighted to have with us to-day the Honorable Andrew W. Mellon, whose sincere desire to make America the best place in this world in which to live and prosper has been the motive back of all his philanthropic contributions. I know that all of you join with Mellon Institute to-day in the pleasure of greeting our eminent founder, the Honorable Andrew W. Mellon.

ADDRESS OF THE HONORABLE ANDREW W. MELLON

The building being dedicated to-day realizes the hopes of many years. My brother and I had long looked forward to this occasion and it would have made him very happy if he could have seen, during his lifetime, the completion of this beautiful building for the Mellon Institute. I wish, too, that Dr. Robert Kennedy Duncan could have lived to see this day and the institute's many activities, for he was, in the beginning, at least, the inspiration of it all.

The manner in which it came about was quite unpremeditated, as those things often are. Strange as it may seem, it all goes back to a school of language and a quite innocent desire on my part to speak French fluently enough to travel abroad in comfort—a desire, I may add, which remains unsatisfied to this day. At any rate, I called on the school for help and they sent a young Frenchman to my house in the evenings during the summer of 1909. He was a very enthusiastic young man, and one night he brought a letter from his father in France who had made a chemical discovery, as he thought, and wanted it tested by some industry in a position to utilize the discovery commercially.

I gave the letter to the chief chemist of the Gulf Oil Company, who reported a few days later that the supposed discovery was not of practical value, and to prove it, gave me a book, just then published, called "The Chemistry of Commerce," by Robert Kennedy Duncan, professor of chemistry at the University of Kansas. I read the book with interest, but the part which particularly enlisted my attention was the last chapter, in which Dr. Duncan described his plans for industrial fellowship, by means of which industry could utilize the services of qualified scientists to solve its problems, in much the same way as is being done here to-day.

After pointing out the confusion and waste in manufacturing, most of which was chemical, not mechanical, he went on to say that with larger combinations of capital and a new generation of business men becoming aware of the possibilities of the new knowledge, improvements were coming and would continue to come in industry as the aid of science was invoked to solve the problems constantly arising.

I was very much interested in these ideas of Dr. Duncan's, for as a result of all my reading and observation it seemed to me that improvement in the standard of living of the human race could come about in the future only by reason of new discoveries and inventions, just as, in the past, the steam engine and other inventions had been responsible for many improvements in the standard of living enjoyed by the average man to-day. It was these things, and not governmental or political action, that had increased production, lowered costs, raised wages, elevated the standard of living and so had brought about a greater participation of the human race in these benefits.

It seemed to me that an institution based on Dr. Duncan's ideas could help in this advance movement; and as my brother was keenly interested in the project, we lost no time in persuading Dr. Duncan to come to Pittsburgh and organize for us here at our university this Institute of Industrial Research. It em-

races, as you know, not only chemistry but biology, r chemical research frequently develops biological scoveries also; and so it seemed fitting to cover both lds in this new and, at that time, unique institution.

Dr. Duncan became our first director and at his ntimely death a few years later, just as the then ew building had been completed, his assistant and ose associate, Dr. Weidlein, took his place and has bly carried on the work, with the happy results of hich you and all the world know. Those results peak for themselves and are the best proof, if any needed, that an institution of this nature, organzed and conducted along the lines Dr. Weidlein has rojected, and with the facilities provided for the pplication of chemistry to industry, fills a useful and mportant place in modern life. The measure of the nstitute's success is the increasing volume of fellowhips which have been established as the value of work urrently accomplished has been demonstrated.

I can not praise too highly all that Dr. Weidlein has done in developing this institution and making it a factor of such constructive value in the life of this country, and, I may say, of the world, for science fortunately has no national boundaries and new discoveries in any country eventually benefit all mankind.

I have been very happy to have a part in this work and feel it has been a great privilege for my brother and me to provide this place where men of science can come in their search for new ways to increase the usefulness of industry, to promote health and so improve the common lot of all. It is science, not governments or wars of conquest, that open to us new horizons; and, as Dr. Duncan so truly said, the new processes and new powers which science will discover will in the future give man the chance to live and to live more abundantly. If this institute can contribute, even in small measure, towards this end, all of us here today can feel that our efforts will not have been in vain.

Mr. Mellon has paid a worthy tribute to Dr. Robert Kennedy Duncan, whose idea, courage and enthusiasm have carried through our organization to this day. "Nothing great," Emerson said, "was ever achieved without enthusiasm." The men engaged in research work at Mellon Institute have this quality to a marked degree, and I can assure you, Mr. Mellon, that your message will add to their courage and determination to succeed. They deserve all the credit for the accomplishments of the institute. This modern building with its majestic columns is the culminating step toward the dream of your brother, Richard B. Mellon, and yourself—the vision of a greater institute beautifully and efficiently housed, in keeping with the character of these scientists' contributions to humanity and to science.

Mr. and Mrs. Richard B. Mellon always were builders, not only of institutions but also of character. These excellent qualities are reflected in their children, Mr. Richard K. Mellon and Mrs. Sarah Scaife. They, together with their mother, have continued the work of Richard B. Mellon. It is impossible to name any worthy measure that has made for civic uplift and benefit in Pittsburgh that has not had the direct friendly assistance of the late Mr. Mellon. His son is a worthy successor and I am honored to present to you Mr. Richard K. Mellon, who represents his father and family. Mr. Mellon.

ADDRESS OF RICHARD K. MELLON

Honored guests and ladies and gentlemen: Well do I recall the opening of the first permanent building of the Mellon Institute in February, 1915. On that occasion I accompanied my father and mother and some classmates from Shadyside Academy. Of course, it was a rather interesting evening for us, but as I reflect, I realize that we younger fellows hadn't the slightest conception of what future developments were to bring forth, or what was contained within the walls of that former building. I am quite sure that none of us appreciated what knowledge of science meant to industry and business at large.

I was fortunate enough in those years to overhear at home the two brothers, my uncle and my father, discuss many times with the late Dr. Robert Kennedy Duncan, and later with Dr. Weidlein, the current findings and future possibilities in the field of scientific research. As time passed, I had an opportunity to become well acquainted with the various events that took place in the progress of industrial research. Those discoveries seemed rather thrilling at that time, as chemical warfare was taking such a prominent part in the great war. Following that period there was a tremendous expansion in industry in this country, as you all know, and it was during this era that research departments were started by corporations of all sizes and kinds.

Following this post-war expansion period came depression, and it is surprising to know how many industries survived on their research findings alone. Many of the products of manufacturing plants at the present time were conceived during the past few years. It has been said, and I think rightly so, that research in this country is responsible in a large degree for our present high standard of living.

When it is realized that there are more than 1,600 industrial research departments associated with nearly every line of industry, the recognition that is given to scientific findings can readily be seen. All these companies have their own particular problem and are at work seeking a solution that will advance their par-

ticular product. In other words, their research is directed in a particular direction forward; but under one roof scientific effort is centered, and because of this, each fellowship is given a broader vision of what is being undertaken by other people in diversified lines.

A general feeling seems to prevail that this is a scientific chemical laboratory, aiding only industry. This is not entirely true, and we can well realize the reason for the misunderstanding. Scientists are so shy about their work that very little is ever published regarding their efforts. The fellows of Mellon Institute are constantly at work doing pure research in the field of biology and have been quite successful in their discoveries. Many lives have been already saved as the result of the individual effort of these fellows, and it is the hope of the founders that they will continue their research in the biological and related fields. Too much praise can not be given them, and I know that they regard success as their chief reward.

This memorable occasion gives me much pleasure, and, at the same time, brings sadness. We had hoped that one of the founders, my father, would have been here with us to participate in this dedication, and it is a disappointment also that his lifelong partner, my mother, had to be absent to-day. They both followed so carefully the progress which the institute has made and enjoyed watching the construction of this beautiful building. Mother has done much to add to the cheerfulness of the interior. We are happy indeed and keenly delighted that the one original founder, the Honorable Andrew W. Mellon, is here to participate in to-day's ceremonies.

Acting in behalf of the founders, I have the honor to say that they have complete confidence in the future under the able guidance of its present director. He has had marked success in the administration of the multiple duties that have confronted him, and keenly appreciates the tasks that are ahead of him. It is a pleasure, at this dedication ceremony, to hand the key of this new building to Dr. Edward Ray Weidlein, director of the Mellon Institute.

Honorable Andrew W. Mellon and Mr. Richard K. Mellon, on behalf of the trustees, executive staff and fellows of Mellon Institute, we accept the great responsibility that you have placed in our charge. These new and unusual facilities for research, in the fields of both pure and applied science, will strengthen our position to add to the comfort, convenience, health, safety, happiness and prosperity of mankind. We wish to express to you our most cordial appreciation for all that you have done for us.

[Dr. Weidlein introduced the guest speakers, who made addresses as follows: Dr. Irving Langmuir on "Chemical Research"; Dr. Harold C. Urey on "The Accomplishments and the Future of Chemical Physics"; and Dr. W. P. Murphy on "Scientific Research in the Solution of Medical Problems." Dr. Weidlein called attention to the circumstance that the speakers were Nobel laureates and made a statement concerning the establishment of the Nobel prizes.]

Long before ideas of the physical form of Mellon Institute's new home had crystallized, two definite decisions were made: First, to fulfil its essential purpose, the building must be the most advanced scientific workshop that modern knowledge could provide. Secondly, it must be beautiful as a tribute to science and to the institute's own achievements—appropriate to the ideals of its founders and in keeping with the imposing architecture of companion buildings in Pittsburgh's civic center.

Although other types of architecture were considered, the preference from the outset was weighted heavily in favor of the Grecian school. The architecture of ancient Greece combines great beauty with the simplicity that is fitting to a home of science. And in the philosophy and the general intellectual curiosity of the Greeks of the golden age, modern science had its beginning. The architecture of the building, therefore, was to be a tangible recognition of the link between the science of early days and the science of the present and future, exemplified in the institute's purpose and work.

It is a fitting climax in our dedication to thank all the skilled workmen as well as the contractors who have converted the thoughts and ideas of the architects and engineers into this beautiful structure. Mr. Alexander Howie and his workmen deserve special mention for their skill in setting the stonework and especially for their unusual engineering ability in putting the columns in place. The total weight of all 62 monolithic columns, including bases and capitals, each with an over-all height of more than 42 feet, is 4,432 tons: here is the largest monolithic column installation in the world. They did not even put a scratch on a single column. We also wish to thank our general contractors, Mellon-Stuart Company, for their splendid work.

The greatest credit goes to the architects, Janssen and Cocken, who were able to take our needs for arrangement and space and to design such an artistic and practical building. In this outstanding work they were aided constantly and faithfully by our own staff engineer, Mr. Harry S. Coleman, who has become the leading expert in this country on laboratory design, and we are proud of him.

Several parts of the new home of the institute have been inserted with symbolic meaning, to render the art

therein emblematic of the purpose of the institution, the beneficence of science, the origin and advancement of chemistry and the value of industrial research. This symbolism was devised by Dr. William A. Hamor, of the institute's executive staff, in cooperation with Janssen and Cocken.

In closing this memorable occasion, I wish to acknowledge with thanks the loyal support which the institute has received from Mr. Henry A. Phillips, our treasurer and a trustee, who has guided us successfully to the completion of the building. We are also grateful to Dr. John G. Bowman, chancellor of the University of Pittsburgh, who has had a very important part in the development of the institute. We maintain close cooperation with the University of Pittsburgh and are deeply appreciative for the splendid support of that institution.

Then, again, let me express our thankfulness to our founders for this splendid institute, which they have created, and, to quote from Dr. Murphy's address, "let us hope that, with the help of men trained in such an institution as this one, the results of research may produce even greater happiness, health and a longer and more efficient life than is now possible."

ROBERT KENNEDY DUNCAN[1]

By Dr. B. T. BROOKS

NEW YORK, N. Y.

IT is impossible to return to Mellon Institute without feeling that the influence of Robert Kennedy Duncan is alive and is a vital force here to-day, even though there are very few of the fellows here who were here when he was alive. It is appropriate to speak of his character here, because I believe that in many respects the character of Robert Kennedy Duncan is the character of Mellon Institute to-day.

I wish that I had his wonderful gift for expression, his beautiful diction. In speaking of the character of Dr. Duncan I feel a great responsibility, since I am for the moment the mouthpiece for those who knew him well and loved him. I do not presume to give you an appraisal of his character. In my opinion the professional biographers who have attempted to psychoanalyze great men have generally done a very poor job of it. And so I shall speak only of a few of the traits of Dr. Duncan's character which most impressed me, and if I omit other qualities which may have greatly impressed others, I admit that the fault is entirely mine and plead also that lack of time prevents making this picture of him as complete as I would like.

There were several outstanding traits of character which I believe could not fail to impress any who were associated with him. These traits were what I term his complete honesty of purpose; second, his great courage and intelligent audacity, and, third, his human qualities. Speaking of Dr. Duncan should not cast a moment's shadow on this very happy occasion. The atmosphere here is in some respects like the celebration of a victory, a victory which was planned by him, together with Mr. Andrew W. Mellon and Mr. Richard B. Mellon, who understood Duncan and his purposes. There is, I think, another element in this celebration which I can only describe as something which warms the heart, and which I associate with those human qualities of Duncan's, and which I believe has come down through the years with those who understood him and have carried on.

Some of you may wonder how all this achievement represented by the new Mellon Institute and its splendid record of past performance has come about. Was it merely that Duncan had conceived a plan of practical cooperation between science and industry, or was it merely that the Mellons had anticipated the New Deal and were seeking for ways to spend money regardless of result?

No, I think it required more than wise planning and resourcefulness to have accomplished what has been done. I believe that one key to the mystery, one cardinal element which made all this possible, was the character of Robert Kennedy Duncan.

It is always interesting to examine the career of a great man and try to discover the more or less hidden clues to his success. In Duncan's case it would be trite to say that he inspired confidence and had rare qualities of leadership.

I assure you that the quality of leadership is still a great deal of a mystery, like genius, and is the subject of a great deal of inquiry. We still debate or privately wonder as to whether or not such great leaders as Jeanne d'Arc or Abraham Lincoln were not really more than mere human clay. We find the rare combination of qualities that we vaguely call leadership in utterly different types of men. Several years ago the American Engineering Societies made a study of the elements conducive to success among engineers. The opinion expressed by the vast majority of about sixteen thousand questionnaires placed character above all other essentials. Some of our military authorities from a study of great military leaders, and failures, have come

[1] Address delivered at the trustees' dinner in connection with the dedication of the new building of Mellon Institute.

to the same conclusion, but the term character alone does not tell us much.

I have mentioned Duncan's complete honesty of purpose. One could not fail to sense this, as Burke said in his great speech on the conciliation of the American Colonies—"Plain honest good intention is as easily perceived as its opposite." Polonius, in Hamlet, uses the phrase, "by indirections find directions out." This was never Duncan's method, and I am told that the confidence of Andrew Mellon and Richard B. Mellon in Dr. Duncan dated from their first interview with him. This quality was of immense value in his leadership when director of the Mellon Institute, since all of us felt that whatever he requested of us must be right. I am sure that this quality impressed industrialists and has led to the establishment of many a research in Mellon Institute entirely aside from other considerations. One day he said to one of the fellows: "Boy, you have discovered something that may be quite valuable to another fellowship and I am going to ask you to give it to them. Understand, you have every right to it and it may seem to you that there is no justice in my request, but, you know, the fellow who is always seeking justice never gets it and is always in hot water." Honesty of purpose is certainly one of the foundation stones of Mellon Institute.

I have often asked myself what his views would have been regarding some of the political and economic feuds of to-day. He would have deplored the class hatreds that are now so rampant. Envy was not in him. He believed there was room for everybody, with work and the possibility of gracious living for all. He often said, "Never be afraid of too much research. We are only spooning up the ocean."

If labor leaders and employers generally had Duncan's point of view, how much easier it would be to settle labor disputes. Barring those cases where passion has been raised, I am sure Duncan could have settled any labor dispute in spite of the fact that he had little of the judicial calm and patience usually supposed to be necessary to adjust such disputes. His pulse beat fast. He was capable of strong emotion and was full of nervous energy; but with his directness and honesty of purpose I know he would have won where too much so-called tact would only have aroused suspicion.

We all found out, after a time, something of what his greater purposes were. He thought deeply of our economic future, and while he would not have proposed that the fullest cooperation of science and industry would be a panacea for all our ills, we did know that this plan was directed toward a future when every one would be able to live fuller, richer and more purposeful lives. How much more rational to attain the more abundant life through the cooperation of science and industry than through experiments with the law and political hocuspocus.

One great quality of Duncan's was his intelligent audacity. This quality is absolutely essential to leadership. People will follow a man who only seems to have this quality regardless of other considerations. Duncan's intelligent audacity was shown by the originality of his industrial fellowship plan, and the intelligence and soundness of the plan is fully attested by the dedication ceremonies in which we are here to participate. His intelligent audacity was also shown by his prophetic statements in his book, "The Chemistry of Commerce," as to what industrial research would achieve. Many of the major prophecies which he made at that time have since been fulfilled. This quality of audacity is generally associated with youth, but it is not always so, and I believe Duncan, at eighty years of age, would have shown enough courage and audacity to have qualified him as a Democratic nominee for the Supreme Court.

It has been pointed out that all Napoleon's marshals became conservative and slow with twenty added years. It was feared at Richmond in 1861 that Lee was too old and that he would be too conservative, but one of his closest friends said that he was one of the most daring men in the army and that Audacity was his middle name. No one ever expressed such views after the campaign of the Seven Days. Barrie in his essay on courage, which he delivered when installed at St. Andrews, spoke of the days when as a cub reporter he lived in a little back hall bedroom, and said, "Those were the days!" of high courage. Yet the elderly Barrie at St. Andrews had evidently lost none of this precious quality.

We need this kind of leadership in research. The greatest rewards in research go to those who have the audacity to break into new fields. Duncan recognized, however, that careful, systematic work was also required and he said that some researches were like a brilliant, daring assault and that others were like siege operations.

It is easy, of course, to be audacious without intelligence, but not in business nor in scientific work. It is only in the field of politics where, as Machiavelli suggests, a great failure can be covered up by the brilliant pyrotechnic display of a new venture.

Some years ago another forceful character, Paul C. Freer, visited a famous research institute, and when asked what they were doing there, he replied "Practically nothing but worshipping at the tomb of the founder." This will not happen here, for the Mellon Institute does not even now completely attain the goal which was set. It is founded upon a dynamic idea, still feels the dynamic influence of its first director,

and the complete satisfaction of human needs and our thirst for new knowledge is beyond the capacity of our imagination.

Other elements of Duncan's leadership were his very human qualities, his warm sympathy, his capacity for emotion and his genuine interest in his associates. These qualities are certainly essential attributes of great leadership. Every soldier in Napoleon's army heard of how after midnight before the battle of Jena the little man took a lantern and helped a squad of gunners get a gun out of the mud and up the slope to its position. Duncan was interested in the personal success of every youngster who worked in these laboratories. He would often put his head through the door of one of the laboratories and say, "Boy, are all your problems solved?" We knew, after a little, that he meant more than our immediate research difficulties. And so I can easily imagine him repeating that question here to-night, notwithstanding this splendid building built by the Mellons, who believed in and shared his vision for better things for us all. Duncan might remind us gently that it is no time to rest on our oars, and he might even say to our director, "Boy, are all your problems solved?"

SCIENTIFIC EVENTS

SYMPOSIA AT THE DENVER MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SINCE the association covers practically the whole field of pure and applied science, it is in an especially favorable position for organizing symposia, particularly on subjects which extend across the borders of special sciences. Indeed, no other American society or association is so well qualified by breadth of interests, large membership, organization into sections and means for publication as is the association for promoting authoritative general synthesis of scientific knowledge. The Denver meeting from next June 21 to June 26 gives every promise of maintaining the high standards in symposia which have been set at earlier meetings.

It will be remembered that at the Atlantic City meeting last winter the Section on Medical Sciences (N) organized a symposium on cancer. The program consisted of 31 papers, which together cover in a systematic manner essentially all that is now known about this dreaded disease. These papers are being brought out in book form under the editorship of Dr. Henry B. Ward. Therefore, medical investigators and practitioners will soon have available at low cost a compact general survey of one of the most important fields of medicine.

At the approaching Denver meeting, the Section on Medical Sciences will present another symposium by distinguished investigators, this time on diseases caused by acid-fast bacteria. This symposium will be characterized by the same thorough planning as that on cancer, the papers falling under four general headings which together cover the whole field. The first will give a review of the bacterial, chemical and pathological characteristics of acid-fast bacteria. The second group will be devoted to tuberculosis and other animal diseases of acid-fast bacterial origin; the third, to leprosy; and the fourth, to human tuberculosis. At the Indianapolis meeting next winter, the same section will present a symposium on syphilis.

A symposium on a widely different subject is being organized for the Denver meeting under the joint auspices of the Ecological Society of America and the association, Dr. H. de Forest representing the former society and Dr. Henry B. Ward the latter. This symposium, which is on "The Scientific Aspects of the Control of Drifting Soils," is also one of a series under a continuing sponsorship. It also has to an exceptional degree both purely scientific and highly practical aspects, and it ranges broadly across geological, climatological, botanical and economic fields.

At another extreme is a symposium on "Cosmic Physics" by the Section on Physics (B) and the Pacific Coast Branch of the American Physical Society. Obviously, this subject has no present direct bearing on such practical questions as health or natural resources. Yet it stimulates the imagination and broadens the spirit. Its appeal is akin to that of philosophy and religion, and in the long course of time it may prove to be even more important to us as thinking beings than many of the so-called practical subjects.

Among other symposia which will be presented at the Denver meeting is one on "Rocky Mountain Spotted Fever," under the joint sponsorship of the Section on Zoological Sciences (F) and the American Society of Parasitologists; one on "Forests and Waters," under the sponsorship of American Foresters; one on "Air-mass Analysis as Applied to Western United States," including the "Dust Bowl" problem, under the auspices of the American Meteorological Society, and one on "Radio Transmission and Solar Phenomena," under the joint auspices of the Section on Astronomy (D) and the Astronomical Society of the Pacific.

This brief sketch of the principal symposia that will be presented at Denver shows the richness and variety of the scientific programs of the approaching meeting of the association. To all these attractions, as well as those of the general lectures and the special programs of the fifteen sections and numerous related societies, are added the unsurpassed summer climate of Denver

and the magnificent neighboring mountains. It requires no prophet to foresee that the meeting will be very successful.

F. R. MOULTON,
Permanent Secretary

FUNDS FOR THE AMERICAN MUSEUM OF NATURAL HISTORY

A PLAN to raise $10,000,000 for the American Museum of Natural History has been announced by F. Trubee Davison, president of the museum. The museum has now an endowment fund of $16,176,640. Annual recurring expenses amount to $431,197, with a deficit of $55,000 for 1937. The new fund would be used to provide an income to cover these expenses and for a ten-year program of development in all departments.

Due to lack of funds the museum is handicapped by insufficient personnel and is unable to fill gaps in its collections, increase its public exhibits, broaden its teaching facilities, maintain its research and keep up to date with the publication of the results of its scientific work.

The expansion plans include an increase of forty per cent. in the staff of librarians, technicians and laboratory assistants, with salaries commensurate with those in similar institutions. The first application of the new funds, after covering the museum's deficit, would be to double expenditures for education. Objective demonstrations of such subjects as eugenics, environmental problems and conservation are planned. A large-scale development of the collection of American mammalogy may be undertaken and among other projects suggested are completion of the Hall of the Races of Man, a New Hall of Man dealing with embryology and the development of man's body and behavior, reconstruction and modernization of the American Indian Halls, the construction of an Australian Hall, a microvivarium, extension of the Reptile Hall and a North American Mammal Hall.

A series of expeditions suggested by the curators include: Field activities in Australia; ichthyological work in South America; expeditions to the California coast and to the Great Barrier Reef of Australia for the study of living invertebrates, and a field program to complete the museum's collection of fossils from every geologic age in the United States.

Mr. Davison is general chairman of the program, A. Perry Osborn, a member of the board of trustees, is executive chairman, Mrs. Winthrop W. Aldrich is vice-chairman, and E. Roland Harriman is treasurer. Other members of the committee for the campaign are George T. Bowdoin, W. Douglas Burden, Clarence L. Hay, Julius S. Morgan, Daniel E. Pomeroy, Leonard C. Sanford and Arthur S. Vernay.

DINNER OF THE SOCIETY OF THE FRIENDS OF SCRIPTA MATHEMATICA

ON the evening of May 9, at the Hotel Astor, New York City, the Society of the Friends of *Scripta Mathematica* held a dinner in honor of Professor Eric Temple Bell, for his contributions to public enlightenment regarding the significance of mathematics as an essential means to general culture. Dr. Bell gave the principal address. Other guests of honor were Professors Cassius Jackson Keyser and David Eugene Smith and Mr. M. Lincoln Schuster, publisher of *Scripta Mathematica*. The speakers included Professors William P. Montague, Edward Kasner and Joseph Shipley. Professor J. Ginsburg, editor of the journal, acted as chairman.

The dinner was attended by more than 150 friends of the journal and of the society. The proceeds of the dinner will be used for the publication fund of the journal, said to be the only mathematical magazine in the world edited by specialists for laymen. In addition to the *Scripta Mathematica*, a quarterly, the first issue of which appeared in 1933, the society publishes a mathematical library of volumes for the general public, the latest of which is "Every Man a Millionaire," by a mathematician with the pseudonym David Dunham. The second series of the "Portraits of Eminent Mathematicians," by Professor Smith, the first of which appeared last year, is in preparation. These portraits, printed with explanatory text by Dr. Smith, are taken from the collection, part of which was presented by Professor Smith to Columbia University on his retirement from active service.

Associate editors of *Scripta Mathematica* include: Dr. Joseph J. Schwartz, executive director of the Brooklyn Jewish Federation, Dr. David E. Smith, Dr. Cassius J. Keyser, Professor Louis Charles Karpinski, Sir Thomas Little Heath, Dr. Adolf Fraenkel, now at the Hebrew University in Jerusalem, Professor Lao Genevra Simons, Vino Loria and Vera Sanford.

In setting forth the purposes of the society, Dr. Ginsburg pointed out that although there were many mathematical journals, they were usually closed to the lay reader and circulated only among mathematicians, and that *Scripta Mathematica*, which includes departments devoted to book reviews, biographies, "recreational mathematics" or unique mathematical puzzles, as well as more formal papers on various aspects of the history and philosophy of mathematics, provides a publication for the man who is not a specialist in the field.

In addition to the issues of the journal, the three books in the mathematics library and the first series of "Portraits of Eminent Mathematicians" were on display. Further publications in preparation were announced, including "Mathematical Ideas in Design," by

Rutherford Boyd, and "Magic Squares and Cubes," by Royal V. Heath.

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT the annual meeting of the American Academy of Arts and Sciences, held on May 12 at its house, 28 Newbury Street, Boston, Mass., it was voted to award the Rumford Medal to William Weber Coblentz, physicist of the Bureau of Standards, Washington, D. C., in recognition of his investigations in heat and light, including the physical study of the firefly, photoelectric properties of materials, the radiation of stars and pioneer work on the temperatures of the planets.

The Rumford Fund was established by a gift to the academy in 1796 from Sir Benjamin Thompson, Count Rumford, from the income of which medals may be awarded whenever the academy sees fit "to the author of any important discovery or useful improvement in light or heat, which shall have been made in any part of America."

At this meeting one foreign honorary member was elected—M. Henri Piéron, psychologist, University of Paris—and sixteen fellows, of whom the following represent the scientific sections of the academy:

Class I—Mathematical and Physical Sciences

Kenneth Tompkins Bainbridge, assistant professor of physics, Harvard University.

John Tileston Edsall, assistant professor of biological chemistry, Harvard University.

Gustavus John Esselen, consulting chemical engineer, Boston.

Joseph Henry Keenan, associate professor of mechanical engineering, Massachusetts Institute of Technology.

Ernest Orlando Lawrence, professor of physics, University of California.

George Walter Stewart, professor of physics, University of Iowa.

Jabez Curry Street, assistant professor of physics, Harvard University.

Harald Malcolm Westergaard, professor of civil engineering, Harvard University.

Class II—Natural and Physiological Sciences

Walter Walker Palmer, director of medical service, Presbyterian Hospital, New York City.

Alfred Sherwood Romer, professor of zoology, Harvard University.

The following officers were elected for the coming year:

President: Dugald Caleb Jackson.
Vice-president, for Class I: James Flack Norris.
Vice-president, for Class II: Walter Bradford Cannon.
Vice-president, for Class III: George Grafton Wilson.
Vice-president, for Class IV: Arthur Stanley Pease.
Corresponding Secretary: Leigh Hoadley.
Recording Secretary: Tenney Lombard Davis.
Treasurer: Ingersoll Bowditch.
Librarian: Hervey Woodburn Shimer.
Editor: Charles Henry Blake.

Professor Percy W. Bridgman spoke on "Physical Phenomena at High Pressure."

THE DIRECTORSHIP OF THE HOSPITAL OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

DR. THOMAS MILTON RIVERS, at present a member of the Rockefeller Institute, has been selected as director of the Department of the Hospital of the Institute to succeed Dr. Rufus Cole, who has reached the age of retirement and is withdrawing from the directorship of the hospital on June 30.

Dr. Cole has been director since its founding in 1910. When the institute was started, provision was made only for laboratories; but after a few years had elapsed the need became apparent for a hospital in which disease could be studied as it actually occurs in man. An additional gift to the funds of the institute by John D. Rockefeller made the hospital possible; and Dr. Cole, an associate in the department of medicine at the Johns Hopkins Medical School, was chosen to be placed at its head.

At that time hospitals having for their major function the investigation of disease were practically unknown. Dr. Cole started by selecting a small group of men with special interests in the basic sciences; and in the construction of the hospital building he arranged to have wards and laboratories in close proximity, so as to make readily available for the analysis of the phenomena associated with disease the techniques that had been provided through advancement in the sciences of physics, chemistry and biology. He has directed his energies and those of his staff toward the study of the common diseases which affect a large number of persons. Acute respiratory diseases, rheumatic fever, diseases of the heart, Bright's disease and the exanthematous diseases of childhood are among those which have been subjected to almost uninterrupted investigation at the hospital. No less than thirty men who have worked with Dr. Cole in the Hospital of the Rockefeller Institute now hold professorships in the medical schools of the United States and abroad.

Dr. Rivers was associate in the department of bacteriology of the Johns Hopkins Medical School, remaining there until his appointment as associate in the hospital of the Rockefeller Institute in New York in 1922. In 1927 he was appointed to membership in the institute. While at the Johns Hopkins University, he conducted studies on influenza bacilli, which resulted in the discovery of a new bacterium, *Hemophilus parainfluenzae.* Later at the Rockefeller Institute he undertook investigations of the filterable

viruses. These led to the discovery of Virus III and the development of methods of growing viruses in tissue cultures. A vaccine prepared from cultured virus is now available for the prevention of smallpox in human beings. He has worked on psittacosis and has developed a safe method of diagnosing the disease by the use of white mice instead of birds. His most recent work has dealt with a new disease, lymphocytic choriomeningitis, that attacks the central nervous system of man.

SCIENTIFIC NOTES AND NEWS

FELLOWS of the Royal Society, London, were elected on May 6 as follows: John Desmond Bernal, lecturer in crystallography, University of Cambridge; Albert Charles Chibnall, assistant professor of biochemistry, Imperial College of Science and Technology; George Roger Clemo, professor of chemistry, Armstrong College, University of Durham; Alan Nigel Drury, M.D., lecturer in pathology, University of Cambridge; Harold Munro Fox, professor of zoology, University of Birmingham; William Edward Garner, professor of physical chemistry, University of Bristol; Sydney Goldstein, Ph.D., lecturer in mathematics, University of Cambridge; Percival Hartley, D.Sc., director of biological standards, National Institute for Medical Research; Herbert Leader Hawkins, professor of geology, University of Reading; the Rev. John Ernest Holloway, lecturer in botany, University of Otago; William Hume-Rothery, D.Sc., Warren research fellow of the Royal Society; Thomas Godfrey Mason, Sc.D., Cotton Research Station, Trinidad; James Reid Moir, archeologist; Marcus Laurence Elwin Oliphant, Ph.D., assistant director of research, Cavendish Laboratory, University of Cambridge; Carl Frederick Abel Pantin, Sc.D., lecturer in zoology, University of Cambridge; David Randall Pye, Sc.D., deputy director of scientific research, Air Ministry, and Edmund Clifton Stoner, Ph.D., reader in physics, University of Leeds.

PROFESSOR W. L. BRAGG, Langworthy professor of physics in the University of Manchester, has been appointed director of the British National Physical Laboratory. He will assume duty in the autumn.

DR. T. MADSEN, chief of the State Serum Institute in Copenhagen, has for the seventh time been elected president of the Health Committee of the League of Nations. Dr. Madsen recently gave the Abraham Flexner lectures at Vanderbilt University, where he was in residence during March and April.

THE council of the British Royal Institute of Public Health has awarded the Harben Gold Medal to Sir Frederick Gowland Hopkins, professor of biochemistry at the University of Cambridge. The medal is awarded triennially under a trust created by the late Sir Henry Harben "to the person, irrespective of nationality, who, in the opinion of the council, has rendered the most eminent services to public health."

THE Patrons' Medal of the Royal Geographic Society, London, has been awarded to Lincoln Ellsworth for his Antarctic flight of 1936.

THE Société Nationale d'Acclimatation de France has awarded its 1936 silver medal to Dr. George S. Myers, of Stanford University, in recognition of his researches on fishes, particularly the smaller tropical fresh-water species. The presentation was made on March 15 by M. Albert Lebrun, president of the French Republic.

DR. JAS. LEWIS HOWE, dean of the School of Applied Science and head of the department of chemistry of Washington and Lee University, has been awarded the Herty Medal of the Southern Division of the American Chemical Society "for outstanding work on chemistry in the south."

THE Army Ordnance Association has conferred its Medal of Merit upon Major General J. G. Harbord, chairman of the Board of the Radio Corporation of America. The ceremony of presentation took place on May 12 at the Mayflower Hotel, Washington, D. C.

DR. WILLIAM H. DOHERTY, of the Bell Telephone Laboratories, has been awarded by the Institute of Radio Engineers the Morris Liebman Memorial Prize for 1937, in recognition of his work in the field of radio-frequency power amplifiers. The presentation was made at the annual dinner of the institute in New York on May 12.

THE doctorate of science has been conferred by Clemson College on Dr. George W. Keitt, head of the department of plant pathology of the University of Wisconsin, in recognition of his contributions in the field of plant diseases. The degree was conferred on the occasion of the dedication of the new agricultural building on May 12.

THE degree of doctor of science will be conferred at the summer convocation of the University of Durham on Sir Henry Dale, director of the National Institute for Medical Research.

DR. DAVID RIESMAN, emeritus professor of clinical medicine at the School of Medicine of the University of Pennsylvania, professor of clinical medicine in the Graduate School of Medicine and professor of the history of medicine in the Graduate School of Arts

and Sciences, was the guest of honor at a testimonial dinner on his seventieth birthday, March 25. Dr. Russell S. Boles was toastmaster, and the speakers included: Dr. Josiah Penniman, provost of the University of Pennsylvania; Dr. William Gerry Morgan, Washington, D. C.; Dr. Henry A. Christian, Boston; Dr. Lewis A. Conner, New York; Dr. Alfred Stengel and Dr. Wilmer Krusen. A volume of his selected writings was presented to Dr. Riesman, in which is an engraved plate bearing the names of his former and present assistants.

DEAN EMERITUS FREDERICK J. WULLING, of the College of Pharmacy of the University of Minnesota, was the guest of honor at the fifty-third annual banquet of the Minnesota State Pharmaceutical Association in St. Paul. Dean Wulling, who retired in the spring of 1936 after a career that began at the university in 1892, was presented with a memorial plaque by members of the association "in honor of his distinguished service."

DR. ELMER K. BOLTON, chemical director of the E. I. du Pont de Nemours and Company, has been elected a director of the American Chemical Society. Dr. Bolton succeeds Dr. Frank C. Whitmore, of Pennsylvania State College, who will become president of the society on January 1.

PROFESSOR WILLIAM CARUTH MACTAVISH, administrative chairman of the department of chemistry of Washington Square College, New York University, has been elected chairman of the New York Section of the American Chemical Society.

DR. WESLEY R. COE, for twenty-eight years professor of biology at Yale University, will retire after a year's leave of absence beginning at the close of the present academic year.

DR. LINUS PAULING, professor of chemistry at the California Institute of Technology, has been appointed George Fisher Baker lecturer in chemistry at Cornell University for the first term of the year 1937–38.

DR. HARALD M. WESTERGAARD, Gordon McKay professor of civil engineering at Harvard University, has been appointed dean of the Graduate School of Engineering.

DR. ERWIN E. NELSON, professor of pharmacology of the Medical School of the University of Michigan, has been made head of the department of pharmacology at the School of Medicine of Tulane University of Louisiana, New Orleans, succeeding Dr. John T. Halsey, who is retiring at the close of the present session.

DR. GEORGE E. WAKERLIN, professor of pharmacology and physiology at the School of Medicine of the University of Louisville, has been appointed professor and head of the department of physiology at the College of Medicine of the University of Illinois. Dr. Wakerlin will succeed Dr. Maurice B. Visscher, who was recently appointed professor and head of the department of physiological chemistry at the School of Medicine of the University of Minnesota.

MISS MABEL HEREN, in honor of thirty years' service as a member of the department of mathematics of Knox College, has been appointed to the Henry M. Hitchcock chair of mathematics.

DR. JULIA M. SHIPMAN, assistant professor in the department of geography at Mount Holyoke College, has leave of absence for the academic year 1937–38 to teach at Ginling College, Nanking, China.

DR. GEORGE A. HARROP, of the Johns Hopkins Hospital, has become director of research on the staff of E. R. Squibb and Sons, of New York. A new research laboratory is in process of construction at New Brunswick, N. J. Investigation along scientific lines will be carried on without necessary regard to its immediate practical outcome. It is also planned, in the near future, to undertake active clinical investigation with which to supplement and give orientation to the laboratory studies.

CLARENCE L. FORSLING, director of the Appalachian Forest Experiment Station at Asheville, N. C., has been appointed assistant chief forester in charge of the research activities of the U. S. Forest Service. He will supervise the work of the Divisions of Silvics, Forest Influences, Range Research, Forest Products and Forest Economics, which are carrying on specialized investigations in the protection and management of forest and range lands, the utilization of wood and other phases of forestry.

ERNEST SEGESSEMANN, a member of the laboratory staff of the National Oil Products Company, Harrison, N. J., has been made chief chemist of the company's new plant at Cedartown, Ga.

DR. WILLIAM CROCKER, director of the Boyce Thompson Institute for Plant Research, has been elected president of the Board of Education of Yonkers, N. Y.

DR. ERNEST O. LAWRENCE, professor of physics and director of the radiation laboratory at the University of California, spoke on "Atoms, New and Old" at the St. Louis University Medical School on May 12.

DR. P. W. ZIMMERMAN, of the Boyce Thompson Institute, Yonkers, N. Y., spoke before the Sigma Xi Club of the University of Florida on April 22. His subject was "Plant Responses to Hormone-like Substances."

DR. FREDERICK C. LEONARD, chairman of the department of astronomy of the University of California at Los Angeles and president of the Society for Research on Meteorites, gave on April 7 an illustrated lecture entitled "Visitors from Cosmic Space," before the University Chapter of the Society of the Sigma Xi.

THE Linacre Lecture of the University of Cambridge was delivered by Dr. A. V. Hill, Foulerton research professor of the Royal Society on May 10. His subject was "The Heat-Production of Muscle and Nerve: A Critical Survey."

IN the account of the presentation of the medals of the National Academy of Sciences printed in the issue of SCIENCE for May 7, the address on presenting the Henry Draper Medal to Dr. C. E. Kenneth Mees is in error attributed to Dr. Frank Schlesinger. The address was read by Dr. Schlesinger, but should have been signed by Dr. V. M. Slipher, director of the Lowell Observatory, who is chairman of the Draper committee.

THE annual meeting of the Royal Institution of Great Britain was held on May 1. The London *Times* states that it was reported at the meeting that the total membership of the institution, which has been increasing for several years, is now 1,055. The library reconstruction was completed in October last, at a cost, as the accounts showed, of upwards of £15,000. The amount the institution has received by the bequest of the late Mr. Harry Brown is now announced as £29,000. The account of the Davy Faraday Research Laboratory, which is attached to the institution, showed a deficit for the year of nearly £2,000; but the chairman was able to announce a promise by Sir Robert Mond, honorary secretary of the laboratory, to meet this deficit. The following were elected for the year 1937–38: *President,* Lord Eustace Percy; *Treasurer,* Sir Robert Robertson; *Secretary,* Major Charles E. S. Phillips.

THE College of Physicians of Philadelphia held on May 14 and 15 a celebration of the hundred and fiftieth anniversary of its founding in 1787, the year of the Constitutional Convention. The speakers were Roland S. Morris, president of the American Philosophical Society; Dr. David Riesman, professor of the history of medicine in the Graduate School of Arts and Sciences of the University of Pennsylvania; Sir Henry Dale, director of the British National Institute for Medical Research, and Dr. Hans Zinsser, professor of bacteriology in the Harvard Medical School.

AN international colloquium on the physiology of the sex hormones, under the presidency of Professor Pol Bouin, of the faculty of medicine of the University of Strasbourg, will be held in Paris this June under the auspices of the Singer-Dolignac Foundation. Twenty investigators particularly qualified by their work in the subject have been invited to attend, all expenses being defrayed by the foundation. Those in the United States who have received invitations are Dr. Frederick L. Hisaw, professor of zoology at Harvard University; Dr. Edgar Allen, professor of anatomy at Yale University; Dr. Philip Smith and Dr. Aura E. Severinghaus, of the College of Physicians and Surgeons, Columbia University, and Dr. Carl G. Hartman, of the department of embryology of the Carnegie Institution of Washington at Baltimore.

CONSTRUCTION work on the extension of the School of Medicine of Columbia University was begun on April 1. The plans, which will necessitate an expenditure of $600,000, provide for the addition of ten stories to the present six-story extension of the west wing of the building at the Columbia Medical Center. The additional space will be used mainly to house the research laboratories of the five graduate departments—anatomy, pathology, biochemistry, physiology and bacteriology—which now are confined to the lower floors of the wing.

DISCUSSION

THE NEEDS OF THE MIMICRY THEORY

IT seems inevitable that any adverse criticism of the theory of mimicry should bring forth more examples and arguments in its support, of the kinds which have long been on record. Professor Carpenter[1] has therefore done the expected in coming to the defense of the theory after the critical discussions in the author's recent book[2] on evolution.

No attempt will be made to refute his arguments or to show *individually* why the cited examples do not prove mimicry to be the thing it has been claimed to be. The examples could not be proved meaningless without a very much closer study than is possible from the few facts known and recorded. It is likewise true, though not so pleasant a thing to say, that of the examples, new and old, few or none could be successfully advanced to prove the advantages and the origin of mimicry without a much closer study of them than has ever been made. If the same rigid requirements were insisted upon for proof as are currently demanded for disproof, the theory would hardly have gained prominence. We are called upon to accept mimicry until it has been clearly disproved, whereas it would be more logical to reject it until clearly estab-

[1] SCIENCE, 85: 356–359, 1937.
[2] A. F. Shull, "Evolution." New York: McGraw-Hill Book Co. 1936.

shed. It is the author's view that the latter has not happened, though he is quite willing that it should.

Unless proponents and opponents agree on standards of evidence it is not likely that either will satisfy the other. There is no common ground for discussion until the fundamental question, what is involved in judging mimicry, is settled. Examples mean nothing unless it is understood what they must show. A critical biologist will hold that these judgments lie mainly in two fields, genetics and animal behavior—the former relating to the origin of mimicry, the latter to its current value to the mimics.

Into the first of these fields Professor Carpenter would prevent us from entering, on the ground that the problems of mimicry are questions, not of origin, but of survival. If students of mimicry are all prepared to subscribe to that view, a long step toward simplification will have been taken. However, there were certainly some supporters of mimicry in the past who held that mimics came to be what they are because of the advantage it brought to them. The mimicking types were supposed, by these naturalists, to arise out of non-mimicking stocks, gradually through the accumulation of modifications leading to greater and greater similarity to some protected form. This involves survival, but it also includes successive mutation.

It makes a great deal of difference whether similarity to a protected and unrelated animal came about by a single change or by many. If students of mimicry are all agreed that mimicking color, form or habit arose by one mutation in a type possessing no approach to the protecting quality of the model, the argument is simplified and a good deal of history of the evolution idea is now ancient history. If there still be some who maintain that mimicry arose gradually, a distinction will have to be made, and two kinds of arguments advanced to oppose the two kinds of mimicry. If Professor Carpenter is correct in saying that only survival, not origin, is involved in mimicry, which implies the one-mutation origin of the imitations, then the advantage of the new character had nothing to do with its nature. A mutation occurred, often involving (we have been told) many details, and it happened to help its possessor. Since the details have been important in creating the illusion in the minds of predators, the single mutation was a rather remarkable occurrence. Yet its nature was wholly accidental. The marvels of mimicry thus become the wonders of the physiology of development. The latter field is one which the geneticists hope to make their own, but it is important that students of mimicry take the lead in this particular phase of the problem.

Addressing now those who perhaps still believe that mimicry arose gradually, that perfection of the mimic involved many steps, one should point out that survival must be aided by successive mutations which must occur in an order that will build up greater and greater resemblance. If this concept of mimicry be adopted, it becomes of the utmost importance to the theory to know by how many genes a mimic differs from its non-mimetic relatives, how many of these genes have anything to do with appearance, and what phenotypes would result from various combinations of smaller numbers of the differentiating genes. Only with such knowledge can we have any reason to adopt any theory of either origin or survival.

Whichever view of the simplicity or complexity of mimicry be adopted, knowledge of origin belongs in fields which the geneticists claim. If the problems of mimicry are not geneticists' problems, whose are they? They *should* be the problems of all who believe that mimicry as an advantage exists. Students of mimicry are appealed to to furnish the necessary analyses. They know the phenomena in nature; they know, or can learn better than any one else, how to rear the mimics and their relatives; and they have a better opportunity to discover which ones, despite their specific distinctions, still can be crossed. If they can be convinced of the need of these genetic analyses, the outlook for progress is by no means dull.

Let us turn now to animal behavior, the field in which Professor Carpenter holds the entire argument to lie. He implies that it is somehow reprehensible to comment "on the danger of drawing conclusions from experiments on animal behavior," and then cite experiments on the color vision of fowls. Professor Carpenter has missed most of the point to this caution. It is of the greatest importance that there be experiments on behavior. But they must be adequate ones. Without them we go on deciding on very meager bases what an animal "likes" by something that it does, what it "perceives" by some small item of its behavior, what is "suggested" to it by an appearance that suggests something to us, what reaction it gives to a "black and stinking" beetle which impresses us as deserving those adjectives, what it "wants," what it "endeavors" to do. It is very difficult to make the study of animal behavior objective. That is why this branch of biology is one of the least developed of the biological disciplines. Why should we pretend it is easy and continue to form judgments from a few observations? They are almost certain to be wrong in part. We do not even know the entire basis of human behavior. There is not one among us who can say exactly what all elements enter into a judgment. Try as we may to be objective, we all occasionally fail; and when we recognize our failing, we often can not tell what emotion or feeling it was that supplanted reason or a fact. How can we judge other animals' behavior when we do not know

the basis of our own? How likely are we to judge it correctly if, under these circumstances, we insist on judging?

As for experiments on behavior relating particularly to mimicry and warning color, there appears to be only one series that was at all adequate. They were the tests made by Reighard[3] on coral reef and other small fishes and their neighboring predators. Professor Carpenter does not mention these experiments. They turned out to be against the warning color theory, and upset a number of preconceived ideas of how these fishes behave and why they do so. Nor does he mention the stomach contents of birds (McAtee[4]), which are one of the consequences of animal behavior. These go to show that many animals held to be protected, whether through imitation or otherwise, are not very immune to capture after all. It will require a good many casual observations and brief tests to overthrow a thorough, analytical and objective group of experiments and a mass of concrete facts on feeding habits. That is why such tests should cease to be casual and brief. Nothing less complete than the Reighard experiments will suffice, and students of mimicry are urged to make their tests of behavior as full and inquisitorial. The only alternative is to refrain from drawing conclusions.

"Few critics seem to be aware of the great extent of the phenomenon." Were its extent twice as great, its problems would not be solved. What mimicry needs is not a broader foundation, but a deeper one. Those who have made known the large number of instances of it are in the best position to furnish this depth. It is to be hoped they will direct their chief energies to that end.

A. FRANKLIN SHULL

DEPARTMENT OF ZOOLOGY
UNIVERSITY OF MICHIGAN

HETEROTHALLISM IN VENTURIA INAEQUALIS

IN October, 1935, conidia from cultures obtained by isolating each of the eight spores of an ascus of *Venturia inaequalis* were used to inoculate the leaves of potted Fameuse apple trees that had been held in cold storage and recently forced out in the greenhouse. Conidia from each isolate were used alone and mixed in every possible two-isolate combination. Infection resulted from every inoculation, whereas uninoculated trees remained free from it. Leaves from the experimental trees were overwintered and examined microscopically for perithecia of *V. inaequalis*. None of the uninoculated leaves or those inoculated with conidia from any single isolate of the fungus bore perithecia. The results from the two-isolate inoculations showed that the eight isolates fell into two groups of four each. All the 16 possible combinations between the two groups yielded perithecia that bore ascospores. None of the 8 combinations in which conidia from a isolate were mixed with those from another within the same group yielded perithecia that bore ascospores except in three cases, in each of which the fertile ascocarps were borne in a strictly localized area. These seemingly aberrant cases are thought to have been due to contamination. Cleared-leaf studies showed that perithecial initials were formed abundantly when single isolates or non-fertile mixtures were used, but they usually attained less than one half the diameter of the normal, mature perithecium. The experiment is being repeated with modifications and supplemented by pure-culture studies. The available evidence seems to justify the conclusion that *V. inaequalis* is heterothallic, each isolate being hermaphroditic and self-sterile.

G. W. KEITT
D. H. PALMITER

UNIVERSITY OF WISCONSIN

AN ANALOGUE OF PLATEAU'S SPHERULE

IF a falling stream of water is examined with a stroboscope at the point where it breaks up into drops, a tiny droplet may be seen formed apparently from the "tails" between successive drops. This droplet is generally known as Plateau's spherule, after the inventor of the stroboscope.

While emptying two flasks with special constricted necks, I was very much interested to observe a similar phenomenon which may be seen quite easily without the aid of stroboscopic vision. The necks of the flasks were so narrow (4.0 mm i.d.) that air entered in discrete bubbles. Between successive bubbles, tiny bubblets of air were formed which could be observed rising slowly through the solution.

The phenomenon was first observed while emptying a saturated solution of barium nitrate in 33 per cent. nitric acid from the flasks. When the flasks were filled with pure water for calibration, no spherules of air were seen on emptying. Apparently, the formation of the tiny bubbles from the thread of air, left as a large bubble breaks off, depends upon a suitable relationship between surface tension, mobility and density of the liquid, for a given type of neck. With concentrated 70 per cent. nitric acid the effect is not as good as with 40 per cent. acid although occasional bubblets may be seen. Fifteen per cent. alcohol is as good as the 40 per cent. nitric acid, and the effect may also be seen quite well with 95 per cent. alcohol. With ethyl ether the formation of the spehrules was also observed. In this liquid there were frequently three

[3] J. E. Reighard, Carnegie Inst. Wash. Pub. 103: 257–325, 1908.

[4] W. L. McAtee, Smiths. Inst. Misc. Coll. 85(7), 1932. Also *Quart. Rev. Biol.*, 8: 209–213, 1933.

four of the spherules between the successive bubbles entering air.

CHARLES H. GREENE

RADCLIFFE COLLEGE

EASIDE SHRUBS: WIND FORMS VS. SPRAY FORMS

ON the basis of recent observations on the lower pe Fear Peninsula, we have found that the so-called ind-form" shrubs owe their form not to the wind *r se* but to the sea spray carried by high winds. arked injury of all the young shoots exposed on the utheast side of the shrub masses (wax myrtle, upon and live oak) was observed following a high utheast wind which persisted for a period of nine- n hours and reached a maximum well above thirty les per hour. We found this injury only on shrubs ated near the strand; those equally exposed to the me wind velocity but at a greater distance from the ean showed no injury whatever. And the degree form modification was strictly correlated with the mount of injury found. Relatively low temperatures d cloudy weather prevailed during the time of this ind. Abundant soil moisture was also present, so at the drying effect of the April wind may be ruled t as an important factor.

Injured shoots and slightly protected uninjured ones were washed in distilled water and the water tested for chlorides, using silver nitrate solution. A marked contrast was found in the concentration of chlorides on the surface of exposed shoots *vs.* nearby ones slightly protected.

Immature shoots of a number of woody plants were hand sprayed with sea water and a pattern of injury obtained similar to the injury recently observed on the seaside shrubs.

Plant ecologists have generally attributed the strongly modified form of the seaside woody plants to wind alone. Our observations definitely indicate that the principal factor in producing these "wind forms" is the killing action of sea water carried as fine spray. The young, tender, exposed shoots are so severely injured by the spray that only the protected laterals and leeward terminals develop, resulting in the characteristic, compact, repressed, sloping form.

These peculiarly shaped seaside shrub masses should be called "spray forms" rather than "wind forms."

B. W. WELLS
I. V. SHUNK

NORTH CAROLINA STATE COLLEGE

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

INUTES OF THE EXECUTIVE COMMITTEE

THE spring meeting of the executive committee of e association was held in the Hotel Commodore in ew York City on April 17 and 18. All members of e executive committee were present with the excep- n of the Pacific Coast representative, who was duly cused. The minutes of the Atlantic City meetings approved by mail were presented for record.

In response to an inquiry from affiliated state acad- ies it was voted to reaffirm previous action regard- g academy research grants to the effect that these e primarily for specific research projects according the plan approved and transmitted to all academies d not for meeting the costs of printing the publica- ons of any academy.

Itemized statements regarding the finances of the ices of the permanent secretary and the treasurer, regard to the present status of membership and of eans to be taken to extend the membership of the sociation were laid before the committee and after neral discussion approved.

In order to clear up confusion and possible mis- derstanding it was voted that section secretaries who repare the programs and attend the Denver meeting take charge of the work of the sections are to be reimbursed for travel and expense in accordance with the by-laws.

Correspondence from Mr. Charles S. Baker, legal counsel, was presented. The permanent secretary reported (1) the receipt of an official ruling from the Massachusetts Department of Public Welfare to the effect that under the law the American Association for the Advancement of Science was not required to file returns; and (2) that affidavits by our officers and power of attorney as requested by the legal counsel had been prepared and sent Mr. Baker for use in discussing the taxation of the American Association for the Advancement of Science before the Bureau of Internal Revenue.

Various requests were presented that the travel expenses of certain speakers at the Denver meeting be paid from association funds. The committee expressed its regret that no funds were available to meet these requests.

An extended report was made by the permanent secretary on Occasional Publication No. 4, which is to contain the papers read at the cancer symposium organized by the Section on Medical Sciences for the Atlantic City meeting.

On recommendations of the respective sections fel-

lows were elected as follows: Section on Mathematics, 1; Section on Psychology, 8; Section on Social and Economic Sciences, 5; Section on Medical Sciences, 1.

Dr. E. G. Conklin was elected as representative of the association on the board of trustees of Science Service in place of Dr. B. E. Livingston, who had resigned.

The Psychometric Society was accepted as an affiliated society. This organization has a total membership of 159. Of this number 74 are members of the association, 58 of these being fellows. The society is entitled to one representative in the council.

The American Philosophical Association expressed its acceptance of the invitation to change its status from that of an associated society to an affiliated society.

It was voted to hold the 1940–41 winter meeting in Philadelphia and to authorize publication of this decision.

It was voted to hold the 1939 summer meeting in Milwaukee and to authorize publication of th decision.

It was voted to appropriate to *Biological Abstra* $150 from the treasurer's funds for general purpos the officers of the journal to be notified that this the final grant from the association for this purpose.

The chairman appointed the president and the pe manent secretary representatives of the association f the meeting of the British Association for the Advanc ment of Science, to be held at Nottingham, from Se tember 1 to 8.

Dr. Atherton Seidell was selected as delegate fr the association to the Dix-septième Congrès de Chim industrielle, Paris, from September 26 to October

The committee adjourned at 3:45 P.M., to meet Denver in June. (The usual program calls for t executive committee to meet on Sunday afternoon a evening prior to the opening of the meeting on Mo day, June 21.)

HENRY B. WARD

REPORTS

ACTIVITIES OF MELLON INSTITUTE DURING THE PAST YEAR

THE major event during the past fiscal year of Mellon Institute was the transfer of almost all the organization's activities to its new building, completed after a construction period of six years, and dedicated May 5 to 9 to science and humanity in honor of the institution's founders, Andrew W. Mellon and Richard B. Mellon.

The fiscal year just closed marks the twenty-sixth anniversary of the establishment of the Institute's fellowship system. The expansion of activities made possible by the new building is reflected by the increase in the total sum contributed to the institution by industrial fellowship donors. This sum amounted to $816,315 for the fiscal year, March 1, 1936, to March 1, 1937, bringing the total for the past twenty-six years to $11,478,406.

Sixty-nine industrial fellowships—30 multiple and 39 individual fellowships—were in operation throughout the fiscal year, requiring the services of 125 fellows and 52 fellowship assistants. In operation at the close of the year were 64 industrial fellowships—27 multiple and 37 individual fellowships—on which 114 fellows and 41 assistants held positions. Thirty-three fellowships have been in continuous operation for five years or more, and of this number 15 have been active for 10 years, 11 have concluded 15 years or more of research, and 7 fellowships are 20 years of age or older.

During the calendar year 1936, 1 book, 13 bulletins, 17 research papers and 31 other articles were contributed to scientific and technical literature by Institute members. Fifty United States patents and foreign patents on fellowship inventions came to iss Since 1911, the total number of publications inclu 19 books, 143 bulletins, 744 papers and 1,117 mis laneous articles. During the same period, 668 Uni States patents were granted. Bibliographic bull 4, to be issued later this year, will cover the Institut patents and contributions to literature from 191 1936.

Eleven fellowships began operation during 1936- on the following subjects: household utilities, pl glass, mineral products, pasteurization, drying, pollution survey, chain, raolin, surgical supplies, ch mium and cork. Investigational programs were c cluded by five fellowships: smoke abatement, cosm ics, closure, can and shoes. Three recently accep fellowships will start work this spring.

The activities of the Institute are described in t annual report of the director, E. R. Weidlein. R leasable facts relating to the institution's investig tional progress are here summarized:

Fundamental studies of anthracite fuel beds a heat-transfer methods were made by the anthra fellowship under H. J. Rose. Through the researc of E. P. Barrett, a process has been commercial for the removal of taste- and odor-producing s stances from protective coating materials for f containers. R. R. Fulton's fellowship has develop a hydraulic pressure transmitting fluid for the br systems of automobiles and airplanes. A compreh sive study recently completed by the fellowship he by C. W. Sweitzer on the dispersion behavior of c bon blacks in oil- and varnish-type vehicles will a

greatly in the more satisfactory and wide-spread use of these pigments.

The cottonseed product fellowship in charge of A. W. Harvey has made an investigation of the causes and control of mold development in certain types of cakes. A broad study of plastic fats has established the fact that the shortening properties of these materials are functions of physical and chemical characteristics rather than of biological origin. The basic program of the department-store commodity standards fellowship, under the direction of Jules Labarthe, Jr., emphasized the pre-evaluation of merchandise, the selection of store supplies, the giving of miscellaneous technical aid to the store and its customers and the study of complex complaint cases.

A new strained beef and liver soup, which appeared on the market in 1936, was developed by the multiple fellowship on food varieties headed by E. R. Harding. Material for laboratory table tops, sinks and similar equipment, previously developed by S. M. Phelps of the Institute, has been improved and carried into commercial production by the laboratory fellowship held by E. E. Marbaker. This material has been used in the new Institute building. Under the leadership of H. F. Robertson, studies have been conducted on the synthesis of a number of organic compounds and the development of commercial applications that may follow when such preparations become available in larger quantities.

During the year the petroleum fellowship completed a quarter-century of continuous operation. The work of the fellowship has covered a wide range of problems, including almost all types of petroleum products and uses. W. A. Gruse has been the senior fellow since 1923. A multiple fellowship, held by F. W. Adams, was established during the year to undertake basic researches in plate glass, paints and certain heavy chemicals. Striking correlations have been established between adherence of dry-process porcelain enamels on cast iron and composition and fabrication procedure by the porcelain enamels fellowship under D. G. Bennett. Studies were made by J. H. Young, senior fellow of the multiple fellowship on protected metals, to determine the type of cellular floor unit that would be best suited to residence construction. Investigations of the protective coatings fellowship in charge of G. H. Young have been aimed at the elucidation of fundamental film structure and basic principles determining adhesion, flexibility and continuity of commercial synthetic resin coatings.

Practical production of the new alloy developed last year as an improved razor blade material has been perfected, but the steel has not yet been produced in quantity. E. J. Casselman holds the fellowship concerned. An important addition to sanitational progress in machine dishwashing has been made by the development of sodium hexametaphosphate for this purpose by a fellowship under B. H. Gilmore. Artificial methods to accelerate the weathering of stone up to a hundred-fold have been evolved by the fellowship under R. C. Briant. The procedures were necessary in fundamental studies of commercial marbles and their uses. The practical superiority of plasticized sulfur as a jointing material in brick highway construction has been demonstrated by severe road tests under adverse weather conditions conducted by W. W. Duecker's fellowship.

Research designed to combat silicosis and similar diseases was inaugurated during the year by a fellowship at Mellon Institute under the sponsorship of Air Hygiene Foundation of America, Inc. H. B. Meller is managing director of the foundation, which is now supported by approximately 150 firms in most of the "heavy" manufacturing and mining industries. It is immediately concerned with diseases arising from industrial air contaminants—dusts, fumes, gases and vapors. The purposes of the organization, as set forth in its code of regulations, follow: It shall conduct and stimulate research on problems in the field of air hygiene and gather and disseminate factual information relating thereto. It will cooperate with and assist other agencies active in this domain and will collaborate in the coordination of such investigations.

The program for 1936 involved the collection and evaluation of information available on the subject, and, roughly, its classification into that which is positively established as fact, that which is doubtful or unproved and that which remains to be learned in order to combat air-derived occupational diseases.

Investigations in the cinchona alkaloid field, especially of the chemotherapy of pneumonia, have been continued in the Institute's department of research in pure chemistry, of which L. H. Cretcher is the head and C. L. Butler is senior fellow. In view of the very promising experimental and preliminary clinical results reported last year by the medical collaborators, W. W. G. Maclachlan, H. H. Permar, John M. Johnson and H. H. Burchel, using hydroxyethylapocupreine, more intensive study of this substance has been pursued, and a new and more efficient method of preparing it and other hydroxyalkyl ethers of cinchona alkaloids has been devised. Preparation work has been carried on mainly by B. L. Souther, Mary Hostler and Mary Clapp.

The highly desirable properties of hydroxyethylapocupreine as an antipneumococcic drug, such as high bacteriostatic activity *in vitro*, high protective action *in vivo* (mice), very low toxicity and absence of eye damage, have been confirmed by the medical group. Further clinical tests on a larger number of patients

have been made. While it is fully realized that caution in interpreting clinical data is essential, the present indication from the proportion of recoveries in these treated cases is that the drug has a highly beneficial effect upon the course of pneumonia. The final decision as to its real effectiveness will come only after analysis of many more treated cases than are now available.

The Institute participated in the compilation of the Eleventh Decennial Revision of the United States Pharmacopoeia, which was issued on January 1, 1936, and became official on June 1. In conformity with the policy of the U. S. Pharmacopoeial Convention, the work of revision has continued in order to keep abreast of commercial trends and therapeutic developments and to make available to all users the latest scientific information on the standardization of medicinal agents. The findings of the Revision Committee will be published from time to time as supplements to the Pharmacopoeia and will have official standing from those dates. Study of the official organic chemicals is continuing under the chairmanship of G. D. Beal with the aid of a grant from the Pharmacopoeial Convention. M. W. Green has been appointed as assistant in the Institute's department of research in pure chemistry under this grant.

Research on dental caries has been continued by the fellowship of the Buhl Foundation, which is headed by G. J. Cox with W. E. Walker and Sara F. Dixon as assistants. The study has centered upon the two fundamental aspects of nutritional control of dental caries, namely, (1) the formation of teeth immune to caries and (2) the arrest of decay in existing cavities. The nutritional factors which confer caries immunity may be, but are not necessarily, the same as those which arrest the progress of decay.

The bacteriological and serological investigations started several years ago at the suggestion of Dr. C. B. Schildecker have been continued on an enlarged scale during the year. This work, which is under the general supervision of Dr. R. R. Mellon, director of the Institute of Pathology of the Western Pennsylvania Hospital, is supported by Mellon Institute. The biochemical group (A. P. Locke, with the assistance of Rose B. Locke, Rhoda J. Bragdon and William Thompson) is concerned with the rôle of host factors in pneumococcic infections. The bacteriologists (P. B. Hadley, aided by Faith P. Hadley, F. B. Cooper, Paul Gross, Louise Peebles, L. R. Shinn and Marion L. Lewis) are investigating the development and dispensing of types I and II pneumonia serums and the mechanism of action of an antistreptococcus serum.

SPECIAL ARTICLES

PIMELIC ACID AS A GROWTH ACCESSORY FACTOR FOR A STRAIN OF THE DIPHTHERIA BACILLUS[1]

STUDIES on the nutritional requirements of certain strains of the diphtheria bacillus, which have been carried out during the last few years in this laboratory,[2,3,4,5] have served to indicate the general nature of the materials which must be supplied in order to obtain maximal growth of these organisms. In addition to suitable inorganic ions, these include (1) a readily available source of energy—*i.e.*, glycerol, ethyl alcohol, lactic acid, etc.; (2) certain amino acids, varying individually somewhat from one strain of the organism to another; and (3) one or more substances occurring in meat extract or in extractives from other tissues.

It has already been shown[4] that a boiling water extract of liver offers an adequate source of these latter growth-stimulating materials, a considerable proportion passing into the filtrate after vacuum concentration and precipitation with alcohol, and, further, that from such a solution, after removal of the alcohol in vacuo, the substances in question are readily adsorbed on charcoal and may be eluted from it with acid alcohol.[6]

This eluted material has been purified in a number of ways, keeping in mind always that more than one substance may well be involved. It was eventually found that a separation into two fractions could be accomplished, neither of which alone, in any concentration, would duplicate the effect of small amounts of the mixture with our test strain. This separation was brought about by repeatedly extracting the strongly acidified eluate with ether. The ethereal solution and the residual aqueous layer constituted the two fractions. Again, the possible multiplicity of active substances in one or both of these fractions has had to be kept in mind.

Recalling the work of Pappenheimer[7] in isolating

[1] From the Department of Bacteriology and Immunology, Harvard University Medical School, Boston.

[2] J. H. Mueller, K. S. Klise, E. F. Porter and A. Graybiel, *Jour. Bact.*, 25: 509, 1933.

[3] J. H. Mueller, *Jour. Bact.*, 29: 515, 1935.

[4] J. H. Mueller, *Jour. Bact.*, 30: 513, 1935.

[5] J. H. Mueller and I. Kapnick, *Jour. Bact.*, 30: 525, 1935.

[6] The writer is indebted to Dr. Y. Subba Row, of the Department of Biochemistry of the Harvard University Medical School, and to the Lederle Company, Pearl River, New York, for considerable quantities of liver extract concentrates used in this work; and to Dr. Subba Row, also, for a great deal of active assistance and advice.

the "sporogenes vitamin" of Knight and Fildes,[8] the material contained in the ether extract was sought and found to be present in urine; and here again, as with the sporogenes vitamin, in considerably greater concentration in the urine of herbivors than of man. When calculated back to a liver tissue equivalent, horses' or cows' urine evidently contained a much higher concentration than liver. The isolation of the active material from cows' urine was therefore undertaken.

From one hundred gallons of cows' urine, it is now possible to report the isolation of about 0.25 gram of pimelic acid. This has been identified, first in a preliminary way by titration equivalent, carbon and hydrogen determinations and molecular weight by the camphor method of A. Rast. Identification was completed by mixed melting point determinations with commercial pimelic acid (Eastman) and by mixed melting points of the phenyl-phenacyl esters of the natural and synthetic acids. Physiological identity has been established by the completely satisfactory substitution of commercial pimelic acid for the active material of urine in growth tests with our strain of the diphtheria bacillus.

When added to a suitable control medium, pimelic acid in a concentration as low as 0.01 gamma (1×10^{-8} g) per cc of medium gives a recognizable increase in growth over the control, and a maximum effect is reached with about ten times this quantity. The control alone, containing inorganic salts, lactic acid, an acid hydrolysate of casein enriched by cystine and glutamic acid and the ether insoluble fraction of the liver eluate regularly permits rather poor, scanty growth of our test strain, amounting to about 0.8 to 0.9 mg bacterial nitrogen after three days' growth on 10 cc of the medium. This is increased by pimelic acid to more than 3.0 mg, which—grossly—is a heavy, well-developed pellicle. Increasing the concentration of pimelic acid many times, up to 1.0 mg per cc, has no further effect, either inhibitory or otherwise.

As far as the writer can learn, pimelic acid has not previously been described as a constituent of urine or of animal tissues. Naturally, the possibility exists that the active acid present in liver tissue is not identical with that isolated from urine, and if sufficient material becomes available in the course of the further study of the ether insoluble material now under way, an attempt will be made to settle this point.

A complete report of these experiments will shortly be made elsewhere.

J. HOWARD MUELLER

[7] A. W. Pappenheimer, Jr., *Biochem. Jour.*, 29: 2057, 1935.

[8] B. C. J. G. Knight and P. Fildes, *Brit. Jour. Exp. Path.*, 14: 112, 1933.

BIOLOGICAL ASSAYS FOR FLAVIN AND DERMATITIS FACTOR(S)

I. A SPECIFIC method for the assay of flavin has been found necessary to study the factors in the vitamin G complex. The following procedure was useful as a practical measure of the amount of flavin in biological materials. Albino rats (16 days old) were placed with their mother on a diet consisting of 35 per cent. casein (Labco), 56 per cent. sucrose, 5 per cent. Crisco, 4 per cent. Osborne and Mendel salt mixture and a cod liver oil concentrate (White's) supplying 20 units of vitamin A and 4 units of vitamin D per gram of diet. The rats were weaned at 21 days and placed in separate cages. An extract of rice polishings[1] (90 mg) was supplied daily to provide vitamin B_1 (6 I.U.) and the factor(s) in the vitamin G complex other than flavin. Selected dose levels of the material to be assayed for flavin were fed daily to groups of six rats. The positive control rats received 15 micrograms of pure flavin (Labco) which permitted an average growth rate of 1.5–2.0 g daily for four, six or eight weeks. Concentrated extracts of yeast have been assayed by this method.

Negative control rats showed a characteristic cessation of growth at the end of four weeks. A second type of assay was based on the recovery of these stunted animals with resumption of growth at an average rate of 2.0 g per day for two weeks when 15 micrograms of pure flavin were administered with the daily supplement. This method was more sensitive to lower levels of flavin,[2] but the time required for the complete assay was longer. Extreme depletion (5 to 6 weeks) has produced alopecia and dermal lesions which were cured in approximately four weeks with pure flavin.

II. The same two methods of assay have been employed to measure the factor(s), other than flavin in the vitamin G complex. Flavin (15 micrograms) and vitamin B_1 (6 I.U.) were furnished as daily supplements, together with selected dose levels of the test material, such as an extract of wheat. The rice polishings concentrate[3] (90 mg) as a standard control, permitted an average growth rate of 1.5 to 2.0 g daily for four to eight weeks.

In the second type of assay 30 micrograms of crystalline B_1 (Merck) and 15 micrograms of flavin were fed as daily supplements during the period (3 to 4 weeks) of depletion. The rice polishings concentrate, which also has been shown to contain the dietary

[1] C. A. Cook and R. Carroll, *Ind. and Eng. Chem.*, 28: 741, 1936.

[2] S. Ansbacher *et al.*, *Jour. Nutrition*, 11: 401, 1936.

[3] "Ryzamin-B" (Burroughs Wellcome and Co., (U. S. A.) Inc.).

extrinsic factor,[4] was then substituted for the crystalline B_1 in equivalent amounts. This concentrate (75 to 90 mg) plus the flavin produced a resumption of growth at an average rate of 2.3 to 2.6 g per day, respectively, for four weeks, while a lower dose level (56 mg) yielded 1.3 g per day for the same period. The different growth rates were not due to a variation of the vitamin B_1 intake, which was maintained at a constant level (6 I.U.).

Negative control rats supplied with only B_1 and flavin developed a progressive dermatitis in about five weeks, and several animals died. The swollen and inflamed paws have been cured by administration of the rice polishings concentrate which contained the dermatitis factor(s). The biological factor(s) was stable when the concentrate was subjected to ultraviolet irradiation but was partially destroyed by treatment in an autoclave.

With both types of assay the daily supplements were designed to provide optimal quantities of vitamins so that inadvertent additions with the test materials would not affect the growth rate beyond the biological error. Coprophagy did not become a problem. These methods are being used to assay experimental fractions in a study of the biological factor(s) which have a reputed relation to pellagra and pernicious anemia.

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THE DISTRIBUTION OF GENE FREQUENCIES IN POPULATIONS

THE effects of the various evolutionary factors can be reduced to common terms by considering the rates of change which they tend to bring about in the relative frequencies of alleles within a population. In the absence of such factors, there is a constancy of gene frequencies from the symmetry of the Mendelian mechanism. The frequency (q) of a given gene changes at the rate

$$\Delta q = -uq + v(1-q) - m(q-q_t) + \frac{q(1-q)}{2}\frac{\partial}{\partial q}\log \overline{W}$$

where u is the rate of mutation of the gene in question, v is the rate of mutation to it from its alleles, m is the effective amount of exchange between the local population under consideration and the species as a whole (gene frequency q_t), and $\overline{W}$ is the mean selective value of the array of genotypes characteristic of this population. Gene frequency is in equilibrium (stable or otherwise) at any point at which $\Delta q = 0$ except for variation due to the accidents of sampling among the gametes. The sampling variance for one generation is $\frac{q(1-q)}{2N}$ where N is the effective size of the breeding population. The pressure toward a stable equilibrium in value of q, due to mutation, crossbreeding and selection (assuming persistence of the same conditions for a long period), and the divergent tendency due to inbreeding should between them determine a certain probability distribution of values of q for the local population considered. The following formula is reached, assuming that the selective effects of the gene in question are independent of those of other genes.

$$\varphi(q) = \frac{Ce^{4N\int\frac{\Delta q\, dq}{q(1-q)}}}{q(1-q)}$$
$$= C\overline{W}^{2N} q^{4N[mq_t+v]-1}(1-q)^{4N[m(1-q_t)+u]-1}$$

More generally, selective values depend on the interactions of the entire system of genes. It is the harmonious development of all characteristics that determines the success of an organism, not the absolute grades of the separate characters and still less the composition with respect to a single series of alleles. The mean selective values, $\overline{W}$, of populations characterized by different sets of gene frequencies form a multidimensional surface which in general has many peaks. The joint distribution of the gene frequencies is given by the formula

$$\varphi(q_1, q_2 \cdots q_n) = C\overline{W}^{2N} \prod_{i=1}^{n} q_i^{4N[mq_t+v_i]-1}(1-q_i)^{4N[m(1-q_t)+u_i]-1}$$

SEWALL WRIGHT

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BOOKS RECEIVED

GAMOW, G. *Structure of Atomic Nuclei and Nuclear Transformations.* (Second edition of *Constitution of Atomic Nuclei and Radioactivity.*) Pp. xii + 271. 70 figures. Oxford University Press. $6.00.

JOHANNSEN, ALBERT. *A Descriptive Petrography of the Igneous Rocks.* Vol. III, *The Intermediate Rocks.* Pp. xiv + 360. 178 figures. University of Chicago Press. $4.50.

NORTHRUP, E. F. *Zero to Eighty.* Pp. viii + 283. 13 figures. Scientific Publishing Co. $3.00.

PETERSEN, WILLIAM F. *The Patient and the Weather.* Vol. IV, Part 1, *Organic Disease; Cardio-Vascular-Renal Disease.* Pp. xxxiv + 663. 443 figures. Edwards Brothers. $10.00.

SHELFORD, VICTOR E. *Animal Communities in Temperate America.* Pp. xiii + 368. 306 figures. University of Chicago Press. $3.00.

UBBELOHDE, A. R. *An Introduction to Modern Thermodynamical Principles.* Pp. 131. 11 figures. Oxford University Press. $3.00.

WELLS, VOLNEY H. *First Year College Mathematics.* Part II, *Mathematical Analysis.* Pp. ix + 276. 123 figures. Van Nostrand.

[4] D. K. Miller and C. P. Rhoads, *New Eng. Jour. Med.*, 211: 921, 1934.